A Phenology of the Smaller Dendronotacean, Arminacean and Aeolidacean Nudibranchs at Asilomar State Beach Over a Twenty-Seven Month Period

BY

JAMES NYBAKKEN

(1 Text figure)

Moss Landing Marine Laboratories, Moss Landing, California 95039

INTRODUCTION AND METHODS

Long term studies on the populations of nudibranch mollusks are practically non-existent. This is probably due, at least in part, to the difficulty in finding large populations (Potts, 1970) and to a prevailing feeling that these animals are only transitory members of the communities in which they are found. However, as Thompson (1964) and Miller (1962) pointed out, there are ecologically two groups of nudibranchs, those with short life spans feeding on irregularly abundant prey and characterized by rapid reproduction, and transitory appearances; and those with annual or longer life spans feeding on regularly abundant prey and characterized by annual reproduction and more stable populations. The former species group would fall into what MacArthur (1960) has termed opportunistic species and the latter into his equilibrium species. For the past four years I have been conducting a long-term study of the abundance, diversity and temporal variation in an assemblage of intertidal nudibranchs which fall into the equilibrium ecological group. This study has been conducted at Asilomar State Beach, Pacific Grove, California (long. 121°56′24″ W; lat. 36°37′36″ N). Ancillary to this major study I have also been recording the presence and abundance of the opportunistic species which in this case means most of the eolid, dendronotacean and arminacean nudibranchs. It is the purpose of this paper to report the changes and seasonality observed in the later groups over 27 months.

The study area is an irregular area about 50 meters by 50 meters lying in the low intertidal zone (zone 4 of Ricketts & Calvin, 1968) and is uncovered by tides falling to –0.5 or lower. It consists of dissected granitic rock outcroppings and ridges with several large tidepools. The dominant algae are *Egregia menziesii, Macrocystis integrifolia,* and several species of *Gigartina.*

Since the results reported here were obtained as an ancillary part of the study on the equilibrium group of nudibranchs, the methods were the same as employed in that study. The method was simple. Once each month, save September which had no tides below –0.5, on a date on which the tide fell below –0.5 ft., three qualified observers would enter the study area, each proceeding to his own specified sub-division. Each would enumerate the numbers of individuals of each species of nudibranch observed in a one hour interval.

Early in the study it became apparent that we could not enumerate quantitatively most of the eolid, arminacean, and dendronotacean nudibranchs. This was due primarily to their small size and often cryptic coloration. I therefore removed them from consideration in my study of nudibranch population ecology, but continued, nonetheless, to enumerate them in hope some useful information could be derived.

RESULTS AND DISCUSSION

The species of eolid, arminacean and dendronotacean nudibranchs observed and the months of occurrence over 27 months are given in Table 1 and graphically in Figure 1. The time period for these data is from April, 1971 through June, 1973. I have also plotted (Figure 1) the numbers of individuals enumerated each month. Although I believe that the numbers of species enumerated represent real trends, I do not suggest that they are adequate quantitative samples of true populations, and hence I have not attempted rigorous statistical treatment.

Table 1

Months of occurrence of 17 smaller nudibranchs at Asilomar State Beach

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Oct	Nov	Dec
Dendronotus frondosus (Ascanius, 1774)				3, 5	3	3	3, 4	3, 4			
Dendronotus subramosus MacFarland, 1966					4		4	3?	3	3	
Precuthona divae Marcus, 1961		4		3		3, 5	3, 4		3, 4	3	
Trinchesia lagunae (O'Donoghue, 1926)		5		3, 4, 5	3, 4, 5	4	3, 4		4	3	3
Coryphella trilineata O'Donoghue, 1921	4	4, 5	4, 5	4, 5	3, 4, 5	3, 4, 5	3, 4	3, 4	3, 4	3	3
Doto amyra Marcus, 1961		4			3, 4, 5	3, 4, 5	3, 4	3		3	3
Catriona alpha (Baba & Hamatani, 1963)				5	5	3, 4					
Hancockia californica MacFarland, 1923						3, 5	3	3, 4	3, 4	3	
Spurilla chromosoma Cockerell & Eliot, 1905							3				
Trinchesia flavovulta (MacFarland, 1966)				4, 5		4, 5		3	4		
Trinchesia albocrusta (MacFarland, 1966)						5	4				
Trinchesia fulgens (MacFarland, 1966)					5	4, 5					
Trinchesia abronia (MacFarland, 1966)							4				
Spurilla oliviae (MacFarland, 1966)				5							
Doto kya Marcus, 1961					5	5					
Eubranchus olivaceus (O'Donoghue, 1921)					5						
Eubranchus rustyus (Marcus, 1961)					4, 5	5					
Total number of species present per month over a 3-year period	1	4	1	7	10	12	9	8	6	6	4

Starting month is April 1971
3 = 1971 (Jan, Feb, Mar not counted)
4 = 1972
5 = 1973

I should point out that there are certain species which I have not considered here. These are mainly the larger and more conspicuous forms which ecologically appear to belong to the equilibrium group and are considered in another paper. These species are: *Hermissenda crassicornis* (Eschscholtz, 1831), *Aeolidia papillosa* (Linnaeus, 1761), *Dendronotus albus* (MacFarland, 1966), *Tritonia festiva* (Stearns, 1873), *Antiopella barbarensis* (Cooper, 1863), and *Phidiana pugnax* Lance, 1962.

Of the 17 smaller species reported here, only *Coryphella trilineata* seems to be present during the whole year (Table 1). Not only is it present most of the time, but it usually is the most abundant as well. It is a predator on hydroids and appears, from my observations, to be very catholic in its diet.

If one considers these small nudibranchs as a group, certain definite trends appear in the data. The most important fact which emerges is that both the number of species and the numbers of individuals of these small nudibranchs go up in late spring and early summer and decline drastically in the fall so that few or no species are present during the winter months. In other words, this group of species is very seasonal in their occurrence and the season is the same in succeeding years (Figure 1). Both the numbers of species and numbers of individuals are highly correlated with season (Spearman rank $r_s = 0.99$; $P \ll 0.01$).

Although the food is not known for many of the species, reference to the literature reveals that species in the same genus in other parts of the world feed on hydroids (Thompson, 1964; Miller, 1961; Swennen, 1961). The absence, then,of these species in winter may be due to the absence of suitable hydroid species. That *Coryphella trilineata* is able to persist may be due to the fact that it is capable of switching to whatever hydroid is available and also suggests that the other species are more specialized in their diet. That this latter situation may in fact be the case can be substantiated by noting that *Precuthona divae* prefers to feed on *Hydractinia* sp. and *Eubranchus olivaceus* on *Obelia commisuralis* (Waters, unpublished).

I have not noted the species of hydroids present in the study area during various seasons, but I have noted that

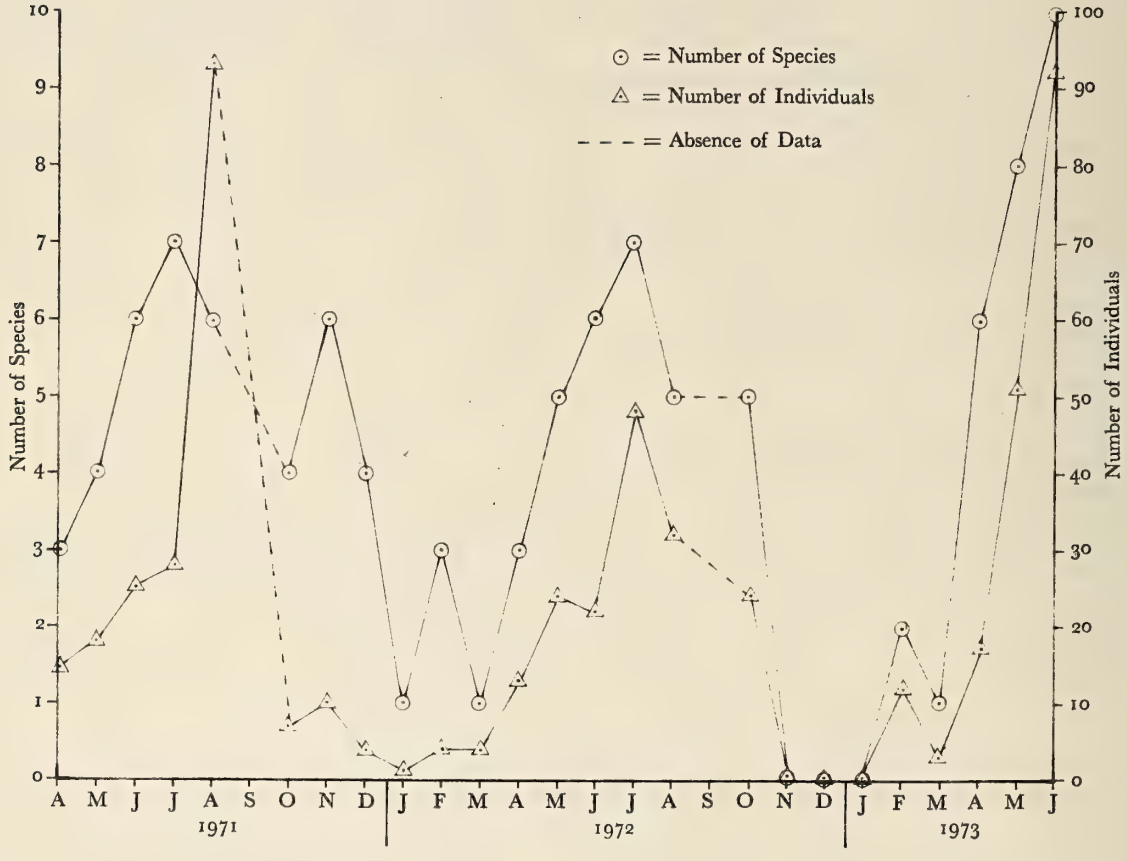

Figure 1

Changes in the number of species and numbers of individuals of eolid, arminacean, and dendronotacean nudibranchs at Asilomar State Beach over a 27 month period

at least some hydroid material is present in every month. Hence it would appear that were all the species to some extent generalists, they should not show the marked seasonality that they do.

It may also be argued that the reason for the lack of these small species in winter is simply a matter of weather. This is the storm season and even at low tide the study area is often flooded by surges from the heavy large waves. Under these conditions it would be easy to overlook these small nudibranchs or, alternatively, they are not out in the tidepools but hiding in the rocks or algae. I cannot prove that this is not the situation, but I do know that periods of very calm, fine weather have often occurred during the winter when we have been counting and still these species were not present. I do not think that we would have missed them had they been there.

Since the time of reappearance of these species seems to be constant, or nearly so, from year to year, it might

also be suggested that this fluctuation in abundance is the result of seasonal migration. That is to say that the species migrate into the intertidal zone in spring and summer from deeper water offshore for the purpose of breeding or feeding, or both. This concept has been discussed by MILLER (1962) who concluded that nudibranch migrations do not occur. After 4 years of observation at Asilomar, I feel certain that migration does not occur in the equilibrium species. In the case of these opportunistic species with their short life spans and small size I find it difficult to believe that they could accomplish the migration necessary to bring them into the intertidal zone, and hence I must agree with Miller.

Thus I conclude that the reoccurring periods of abundance and scarcity on a seasonal basis are real and reflect changes in the conditions necessary for the existence of these species. Though I suggest that the periodicity in the presence of the appropriate food organism is the reason for periodicity in the nudibranchs, other explanations have not been eliminated and should be explored.

Literature Cited

MACARTHUR, ROBERT H.
1960. On the relative abundance of species. Amer. Nat. **94:** 25 - 36

MILLER, MICHAEL CHARLES
1961. Distribution and food of the nudibranchiate mollusca of the South of the Isle of Man. Journ. Anim. Ecol. **30:** 95 - 116

POTTS, G. W.
1970. The ecology of *Onchidoris fusca* (Nudibranchia). Journ. Marine Biol. Assoc. U. K. **50:** 269 - 292

RICKETTS, EDWARD F. & JACK CALVIN
1968. Between Pacific tides. Stanford Univ. Press, Stanford, Calif. v - xiii + 3 - 502; 46 plts.

SWENNEN, CHARLES
1961. Data on distribution, reproduction and ecology of the nudibranchiate Mollusca occurring in the Netherlands. Netherl. Journ. Sea Res. **1** (1 - 2): 191 - 240

THOMPSON, THOMAS EVERETT
1964. Grazing and the life cycles of British nudibranchs. *In*: D. J. CRISP (ed.) Grazing in terrestrial and marine environments, pp. 275 - 295. Blackwell, Oxford, England